**Draft for Discussion**

# REPORTING ON SUSTAINABLE AND EQUITABLE DEVELOPMENT

PROJECT PAPER NO. 1

CONCEPTUAL APPROACH

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October 1993

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# ACKNOWLEDGEMENTS

This paper draws heavily on work undertaken as part of an interdisciplinary Ph.D. program at McGill University (School of Urban Planning, Faculty of Engineering). It is exploring the issue of reporting on sutainability (Hodge, in progress). Primary support for this work has been provided by the Social Sciences and Humanities Research Council of Canada and the Eco-Research Program of the Tri-Council Secretariat.

Three contract assignments have also been completed that have served to clarify many ideas. These include projects with the Yukon Council on the Economy and the Environment (Hodge, 1991), the Ontario Round Table on Environment and Economy (Hodge and Taggart, 1992), and the Science Advisory Board on the International Joint Commission (Hodge, 1993).

Ongoing deliberations of the Task Force on Reporting of the National Round Table on Environment and Economy as well as deliberations of the Round Table itself on the topic have tested and enriched many of the concepts that are presented (see NRTEE, 1993).

In preparation of this paper, Kristin Taggart provided extensive editorial comment for which I am very grateful.

# CONTENTS

page

## FIGURES



## TABLES

# REPORTING ON SUSTAINABLE AND EQUITABLE DEVELOPMENT

# PROJECT PAPER NO. 1: CONCEPTUAL APPROACH

## EXECUTIVE SUMMARY

### ISSUE

1. A practical system of reporting on sustainable and equitable development is needed. It must be sensitive to the needs of both developing and developed parts of the world.

2. AGENDA 21 points out that conventional economic and environmental indicators "do not provided adequate indications of sustainability." It further emphasizes that current methods of monitoring and evaluating progress are inadequate for assessing the "interactions between different sectorial, environmental, demographic, social, and developmental parameters" (UNCED, 1992, Chapter 40). Now, eighteen months after the Earth Summit (UNCED), there is a high level of activity world-wide which is focussed on the development of a practical system of reporting on sustainable and equitable development.

### COMPLEMENT TO EXISTING WORK

3. A number of regular reports currently address conditions in both developing and developed parts of the world. These include:

   - UNDP's ***Human Development Report*** series;
   - UNEP's ***State of the World Environment*** and ***Environmental Data Report*** series;
   - UNICEF's ***State of the World's Children*** series;
   - UNESCO's ***World Education Report*** series;
   - the World Bank's ***World Development Report*** series;

- The World Resources Institute's (with UNEP and UNDP) ***World Resources*** series; and

- The Worldwatch Institute's ***State of the World*** series.

4. Each of these contributions provides critical input to understanding the nature of progress in today's world. But no one of them draws together all the elements that are the building blocks of assessing progress towards sustainable development. Thus, an integrating mechanism that builds on and complements existing efforts is needed.

5. Because the subject matter is complex, there is a danger that reporting on sustainable development will become a vast task, yielding no immediate or tangible results. Such a result is unacceptable. Drawing from existing sources, there are interim steps that can be taken which will yield immediate results while a more comprehensive system is evolving.

6. In practice, the initial challenge will be one of linking with existing sources of information rather than of developing new ones. Capacity building with partner countries will be a primary task.

## THE POWER OF SUSTAINABLE DEVELOPMENT

7. More than in any other single characteristic, the power of the idea of sustainable development lies in its bridging capacity - its facilitation of integration and synthesis. The conceptual framework proposed in this paper is intended as a practical tool for implementing sustainable development by linking relevant interests and building on the "overlapping consensus" that exists among the many stakeholders.

## THE IDRC INITIATIVE

8. The International Development Research Centre is investigating reporting on sustainable and equitable development. This initiative is prompted both by the IDRC's position as a lead organization in the implementation of AGENDA 21 and its mission, ***"Empowerment through Knowledge"***. The Evaluation Unit of the Corporate Affairs and Initiatives Division is responsible for coordination.

9. The initiative will be completed in two phases. Phase 1 will focus on the development of a conceptual framework for guiding the reporting system. In Phase 2, testing will be undertaken in collaboration with a number of partners in developing and developed regions. It is envisioned as a 2 year research project.

10. The final product will be a compatible series of assessments of progress towards sustainable development/sustainability. These assessments may be in the form of traditional print or electronic media. They will contribute to the development of a common direction to guide related initiatives currently underway around the world.

## PURPOSE OF THIS PAPER

11. This paper initiates Phase 1. Its main purpose is to present an overall conceptual framework for discussion. Initial thoughts on the testing methodology are also offered.

## THE QUEST FOR IMPROVED INDICATORS

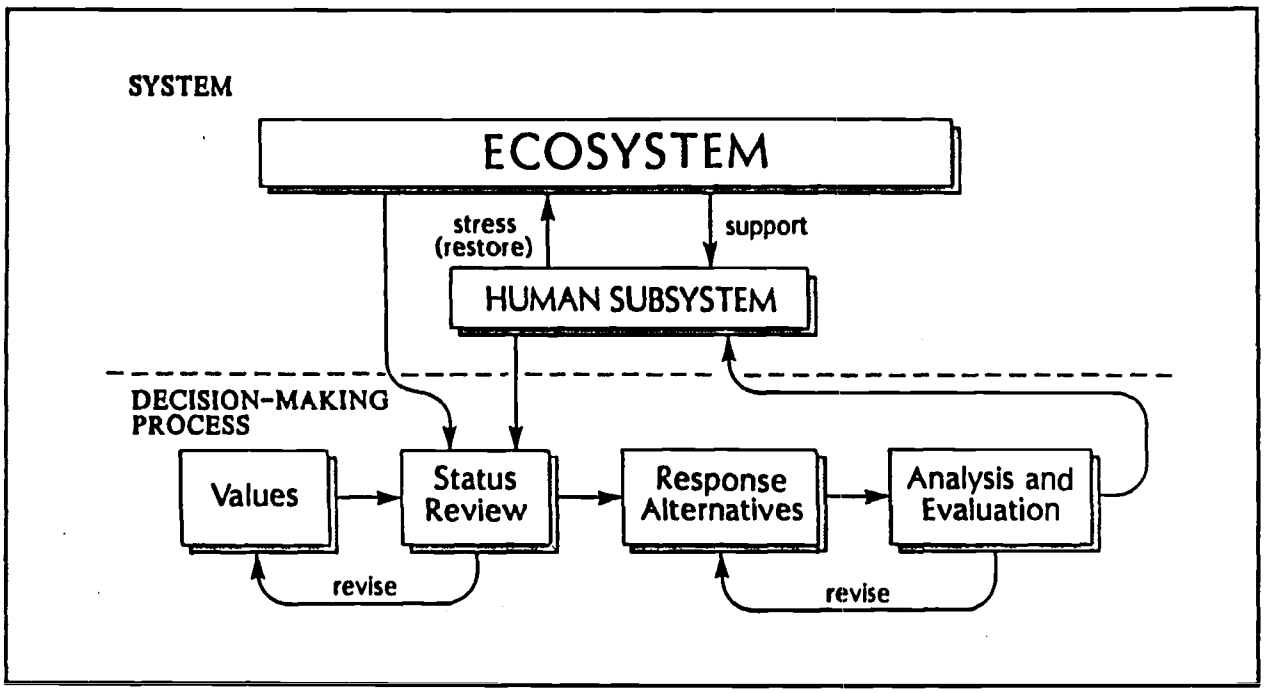
12. Over the past thirty years, a number of attempts have been made to establish improved "indicators" - better means of monitoring society's progress than are provided by traditional economic indicators. None of these attempts has led to the broad acceptance of new indicators. This failure suggests that the search for a new set of indicators should not be pursued as a first step. Before the indicators issue can be successfully resolved, the nature of the overall reporting system, the underlying motivation (the needs being addressed), and the principles that link the system to values must be addressed

13. The development of a general conceptual approach that implements the concept of sustainable development in a practical way will provide the necessary systematic focus for indicator development. Without this approach, indicator development becomes a haphazard process at best.

## CONCEPTUAL FRAMEWORK

14. This work is governed by a set of values that is best described as the care and respect for people and the enveloping ecosystem.

15. The proposed conceptual framework emerges from three sources: (1) the above value set; (2) theoretical treatments of the human-ecosystem relationship; and (3) practice demonstrated in reporting on quality of life, health, economics, development, natural resource use, and state-of-environment through the last 25 years. It links decision-making to the ecosystem, the people, and interaction between the two.




**Conceptual Framework**

## CORE REPORTING ELEMENTS

16. Application of the conceptual framework leads to the identification of a four-part generic report structure that includes:

- **ECOSYSTEM**: an assessment of the integrity, health, or well-being of the ecosystem;
- **INTERACTION**: an assessment of the interaction between people and the ecosystem: how and to what extent peoples' activities contribute to the provision for basic needs and quality of life, how these activities stress or contribute to restoring the ecosystem; and
- **PEOPLE**: an assessment of the well-being of people (individuals, communities, corporations, regions, provinces/states, nations, other decision-making groups) including the range of physical, social, cultural and economic attributes.
- **SYNTHESIS**: an assessment of the whole; key linkages across the above three components.

## THE PRACTICAL LINK TO DECISION-MAKING

17. Reporting is intended to meet the monitoring and evaluation requirements of a larger decision-making system. However, various decision-making groups within any society and in different countries are characterized by different values and motivation. They are culturally distinct and have different reporting needs.

18. Thus, the reporting needs of different groups of decision-makers are used to further define the system. The above structure provides an organizational template that is applied from the perspective of each decision-making group. Common data and information requirements can be identified and gathered efficiently.

19. The following four decision-making groups provide an initial focus: (1) individuals and households; (2) corporations and corporate groupings; (3) communities and settlements; (4) regional, provincial/state, and national governments.

20. This choice is pragmatic although it may be seen as an extension (recognizing the role of communities) of the three components of the conventional model of the market economy which typically includes firms, households, and government. In societies where tribal, clan, or other groupings predominate, this particular choice will not be appropriate. The topic requires careful examination.

## ADDRESSING AGENDA 21

21. A review of AGENDA 21 in light of the proposed system of reporting on sutainability reveals its dependence on current perceptions of issues and its lack of a systematic treatment of the human-ecosystem relationship. Although it does provide an essential listing of current concerns, it does not encourage the kind of anticipatory thinking advocated by the Brundtland Commission.

## TOWARDS PHASE 2 TESTING

22. Test cases for the reporting system will be defined by country, region, community, or any other particular decision-making group. The generic four-part reporting structure will be used to drive Phase 2 testing. The choice of partners will be based on maximizing the use of limited resources, opportunities for building on existing IDRC projects where possible, and seeking variation in the following factors:

    1. **ECOSYSTEM CONDITIONS AND BOUNDARIES:** range of both ecosystem types and conditions;

    2. **PEOPLE** AND **DECISION-MAKING**: range of human conditions; cultures, political systems, and decision-making groups in play;

    3. **HUMAN ACTIVITY AND IMPOSED STRESS**: range of the type and level of human activities and imposed stress on the ecosystem;

    4. **JURISDICTIONS**: variation in aerial extent and population; use of both jurisdictions spanning ecosystems as well as those whose boundaries coincide with ecosystem boundaries; and

    5. **DATA/INFORMATION AVAILABILITY**: range of available objective and subjective data and information.

# REPORTING ON SUSTAINABLE AND EQUITABLE DEVELOPMENT

# PROJECT PAPER NO. 1: CONCEPTUAL APPROACH

## 1. INTRODUCTION

AGENDA 21 points out that conventional economic and environmental indicators "do not provided adequate indications of sustainability". It further emphasizes that current methods of monitoring and evaluating progress are inadequate for assessing "interactions between different sectoral, environmental, demographic, social, and developmental parameters" (UNCED, 1991, Chapter 40).

These statements reflect a growing realization that support for public policy and decision-making must shift from an emphasis on economic considerations to a linked concern for human and ecosystem well-being. Now, eighteen months after the Earth Summit (UNCED) there is a high level of activity world-wide focussed on development of a practical system of reporting on sustainable and equitable development.

Motivated both by its mission ***"Empowerment through Knowledge"*** and its positioning as a lead organization in the implementation of AGENDA 21, The International Development Research Centre is exploring the development of a such a system. Within IDRC, the Evaluation Unit of the Corporate Affairs and Initiatives Division is responsible for coordination.

The needed system of reporting progress towards sustainable and equitable development must:

1. be sensitive to the needs of both developing and developed parts of the world;

2. provide a means of comparative assessment between developing and developed parts of the world;

3. be able to address the diverse elements of AGENDA 21 and the other UNCED documents; and

4. provide guidance for assessing the effects of IDRC programming.

The initiative is being pursued in a two-phase sequence. Phase 1 includes:

1. a review and synthesis of relevant literature;

2. development of a conceptual framework for guiding the reporting system and a methodological approach to field testing;

3. identification of a network of potential contributors and partners and how they might best be linked into the project;

4. identification and assessment of alternative "products" that could be included in the resulting reporting system in both the short- and long-term; and

5. development of a detailed proposal for Phase 2.

In general terms, Phase 2 is envisioned as a two-year collaborative research project. The reporting system will be tested in several developing and developed regions. The resulting product(s) will serve to suggest a common approach for related initiatives underway around the world.

This paper initiates Phase 1. Its purpose is twofold:

1. to propose an overall conceptual framework for the reporting system; and

2. to initiate a discussion of the methodological approach to be used in Phase 2 testing.

## 2. HISTORIC CONTEXT: IN SEARCH OF IMPROVED INDICATORS

The past thirty years have seen a series of calls for new "indicators"[1]. These would allow assessment of development and growth beyond traditional measures of progress that are dominated by economic factors such as employment rates; income; gross national or domestic product (for example, see Henderson, 1981; Waring, 1988; YUCHS, 1990; Anderson, 1991; Hodge, in progress).

In the 1960s the search for new indicators stemmed from a desire to improve the monitoring of the quality of life and social conditions (see Dann, 1984 and Murdie et al., 1992). In the 1970s, the drive to better monitor environmental quality provided impetus (CEQ, 1972; Inhaber, 1976). In the mid-1980s, assessing the health of communities emerged as a concern and sets of "indicators of healthy communities" were developed (Jackson and Nishri, 1988; Hancock, 1989, 1990, 1991, YUCHS, 1990a and b). Since 1990, The United Nations Development

Program has published annual "Human Development Report". Their "human development index" is now gaining recognition as a key indicator of human well-being (UNDP, 1990).

Alternative approaches to economic monitoring have been discussed throughout this time. Feminist scholarship has provided a particularly useful critique of macroeconomic analysis (for example, see Waring, 1988). Recently "ecological economics" has been proposed. This subject is now addressed by The International Society for Ecological Economics (ISEE) and its learned journal, *Ecological Economics*. Natural resource accounting has received much attention through the efforts of the United Nations, the Organization for Economic Co-operation and Development, the World Bank, and workers in a large number of countries around the world including Australia, Brazil, Canada, Costa Rica, France, Germany, India, Indonesia, Japan, Mexico, the Netherlands, New Zealand, Norway, Papua New Guinea, the Philippines, Tanzania, Thailand, the United Kingdom, and the USA.

During the past decade, the soaring costs of health care have prompted a review of health information systems (for example, see NTFHI, 1991). New approaches to identifying the determinants of well-being that attempt to better integrate economic and environmental factors with those traditionally considered are being explored (Evans and Stoddart, 1990).

In the late 1980s and now in the 1990s, the popularization of the concept of sustainable development has brought a new wave of interest in improved indicators. The 1989 G-7 Economic Summit called for such indicators (Kerr, 1990, p. 2), and this same interest is echoed in documents emerging from the 1992 Earth Summit held in Rio, Brazil.

This recent impetus has a two-fold motivation. Firstly, there is growing realization that environmental implications of human activity have now reached a scale which potentially threatens human survival (Ehrlich and Ehrlich, 1991, pp. xii - xiv). Secondly, the serious and growing disparity between conditions in developing and developed countries can no longer be ignored (WCED, 1987, p. 2).

In spite of the high level of interest generated by these initiatives, each set of activities has eventually lost momentum. And while useful insights resulted, widely accepted new indicators have not emerged. This failure suggests that the search for a new set of indicators should not be pursued as a first step.

Before the indicators issue can be successfully resolved, the nature of the overall reporting system, the underlying motivation (the needs being addressed), and the principles that link the system to values must be addressed (see Checkland and Scholes, 1990, p. 112). In other words, the underpinnings and nature of the reporting system will govern the choice and design of an improved set of indicators; any attempt to choose indicators in the absence of a governing framework will inevitably fail. It is for this reason that this project has placed emphasis on development of a guiding conceptual framework.

# 3. CONCEPTUAL FRAMEWORK

## GOAL AND OBJECTIVES

The overarching goal of reporting on sustainable development is ***to improve the way we make decisions - to support informed and responsible decision-making processes.*** Four specific objectives can be listed (Hodge, in progress):

1. to communicate key signals to targeted decision-makers, in particular to give early-warning signals for required policy, institutional, and/or behavioural change;

2. to ensure accountability;

3. to encourage initiative by giving credit where credit is due; and

4. to identify knowledge gaps and provide rationale for choosing priority research and action.

## ACHIEVING RESULTS

In pursuing the above goal and objectives, there is an obvious danger that reporting on sustainable development becomes a vast task, with no immediate tangible results. Such a result is unacceptable. While the existing data and information base is immense, a number of experiments have been completed that we can build upon. Similarly, there are interim steps that can be taken which will yield immediate results while a more comprehensive system is evolving.

## KEY DEFINITIONS

The concept of sustainability is best defined as ***the persistence of certain necessary and desired characteristics of both the ecosystem and the human subsystem within over an apparently indefinite future*** (modified from Robinson et al., 1989). Sustainability is a normative attribute of something such as the ecosystem, biodiversity, development, communities, the nation, the family farm, or society.

Sustainable development[2] focuses on human activities and on related development that ***"meet the needs of the present without compromising the ability of future generations to meet their own needs"*** (WCED, 1987, p. 8). Sustain-

able development's focus on human activities is an appropriate focus of policy development and decision-making. It is human activity rather than the environment that is managed through policy, regulation, and law.

Development is used here in the sense proposed by Daly (1989, p. 4): to realize the potentialities of, and to bring to a better state. Development has both qualitative and quantitative characteristics and must be differentiated from growth which applies to a quantitative increase in physical dimensions.

This work identifies a system which includes people, the enveloping ecosystem, and the interaction between the two. It provides the necessary subject to which the normative label "sustainability" can apply. However, because of the interconnectedness of the ecosystem and people, reporting on progress towards ***sustainability*** in this context cannot be differentiated from reporting on progress towards ***sustainable development***.[3]

## VALUE BASE

The value base motivating this work is best described as a parallel care and respect for the ecosystem and people within it. This value base influences the reporting system directly by the entrenchment of the kinds of characteristics listed in Table 1 below.

## Table 1: Value driven characteristics of a system of reporting on sustainable development.[4]

### RESPECT AND CONCERN FOR THE ECOSYSTEM

- use of a time horizon in the reporting system that captures both human (short) and ecosystem (short and long-term) dimensions of time;
- use of a "multiboundary" spatial analysis that places the assessment of any decision-maker's jurisdiction within the context of ecosystem boundaries and processes;
- analysis of individual ecosystem components (e.g. air, groundwater, surface water, soil, fauna, flora etc.) but within the context of the connected whole (often on the basis of "ecozones" or "ecoprovinces").

### RESPECT AND CONCERN FOR PEOPLE

- use of assessment criteria in evaluating progress that respect the existence of alternative and changing values;
- use of population disaggregations over both space and time that allow assessment of the distribution of environmental, economic, social, and cultural costs and benefits;
- inclusion of ways to measure participation and control in decision-making; and
- use of both objective data and information as well subjective information - intuitive understanding based on experience of everyday life including subsistence and traditional life styles.

### OVERLAPPING

- generation and use of data and information that address the complete range of chemical, physical and biological stress naturally occurring and imposed by human activities on the ecosystem;
- use of an anticipatory perspective with the form of chosen indicators, a time-horizon and an analytic approach that ensures forward looking applications within the reporting process, rather than merely description of past and current conditions;
- recognition and acceptance of uncertainty as an inevitable occurrence rather than an impediment to good decision-making.

## MODELLING THE HUMAN-ECOSYSTEM RELATIONSHIP

A large number of models have been developed over the years that in some way address the human-ecosystem interaction. These models have been motivated by a variety of interests and disciplines including: economics, geography, ecology, health, planning (community, urban, regional, water resources, etc.), resource management, and, most recently, the broad interest areas of sustainable development and sustainability.

A review of thirty different approaches to modelling human-ecosystem interactions was completed during the development of the conceptual framework described in this paper (Hodge, in progress). A list of these models as well as the main conclusions of the review are given in APPENDIX I. The review is partly motivated by the idea of "overlapping consensus" proposed by John Rawls (1987).

Rawls points out that a consensus affirmed by opposing theoretical, religious, philosophical and moral doctrines is likely to be both just and resilient. Public policy based on such an overlapping consensus is therefore more likely to thrive over generations. In this instance, the idea was applied by seeking common elements in the conceptual approaches to modelling human-ecosystem interactions used by various workers from a variety of disciplines. It is interesting to note that some of these workers and disciplines enjoy little or no rapport with the others.

The intent was not to judge the models as right or wrong as most models are appropriate within their contexts. Rather, fundamental elements and relationships that provide a common foundation for all the models were identified. Each model was assessed in terms of its potential for providing a framework for reporting on sustainability. From this perspective, strengths and weaknesses were also identified.

The main conclusions of this review are also listed in APPENDIX I. No single model was identified that could serve as a conceptual framework for reporting on sustainable development. It was apparent the many factors at play require systematic treatment to avoid confusion. Few of these models made explicit their value base and only two implied a parallel concern for both people and the ecosystem. Almost all of the models reviewed offer useful insights for the needed conceptual framework and reporting system.

The most important insight stems from the fact that each model addresses both people and the ecosystem. This leads to the conclusion that the ecosystem, the human sub-system, and the interaction between the two are fundamental to these models as they are to the the conceptual framework proposed here.

## DRAWING FROM STATE-OF-ENVIRONMENT REPORTING

To gain insight into alternative conceptual approaches for assessing and reporting on environmental and related conditions, 220 state-of-environment reports were reviewed. These are grouped in eight categories: global (23 examples); international (9); non-U.S. national reports (68 reports from 54 countries); U.S. national reports (23); provincial/regional (23 from 14 regions); municipal (9 from 4 municipalities); ecosystem component (e.g. air, water, forests, oceans) (47); and company or industry (18). Results of this review are reported in Hodge (in progress).

State-of-environment (SOE) reporting is motivated by principles drawn from the ecosystem itself. It attempts an holistic approach and has taken a leading role in addressing a number of important issues. These include the issues of cumulative effects and of identifying and assessing cause-effect relationships when hard evidence is scant or non-existent. At a project level, it is environmental impact assessment (EIA) including social impact assessment (SIA), that displays the greatest experience of integrating human and ecosystemic issues. However, the review has shown that SOE reporting is not guided by any generally accepted formula or conceptual approach.

The common goal of SOE reporting is simply an overall desire to document environmental conditions and the causal relationships. Links to decision-makers are weak. An explicit understanding of the time and space characteristics that govern ecosystem conditions in comparison with those that govern contemporary decision-making is rarely demonstrated. More recent reports place greater emphasis on the linkage between economic activities, the status of the economy and ecosystem conditions. However, no report has yet demonstrated a fully satisfactory approach to describing this relationship.

In spite of efforts to assume an "ecological" perspective, the vast majority of these reports are driven by a pollution-depletion model of the human-environment relationship that has roots in economics literature. In this model, the environment is seen as an "asset" that provides material, energy, (and aesthetic) resources to drive production and consumption activities within the economic system. As a result of these activities, waste products are formed and then returned to the environment as pollution.

The environmental issue is thus reduced to two components, one dealing with resource use (or misuse, depletion, and scarcity) and the other with pollution. In turn, the solution to the environmental problem becomes one based on wise resource use and pollution reduction. The related reporting then focusses on the stocks and flows of resources and levels of pollution.

This model of the human-environment relationship is inadequate for the resolution of the many linked human and ecosystem issues now requiring attention. It does not facilitate a systematic treatment of human activities, their value in terms

of provision for basic needs and support for an enhanced quality of life. Nor does it recognize the broad range of physical, chemical, and biological stresses imposed on the ecosystem by human activities. Rather it focuses on current and historic concerns in a reactive way which discourages the type of anticipatory thinking advocated by the Brundtland Commission (WCED, 1987).

Health, social issues, culture, and heritage are treated in descending priority. Reporting related to aboriginal peoples or other sub-populations that have a more direct dependence on the natural ecosystem is rare. Nor is there treatment of disadvantaged populations such as the urban poor. The issue of equity does not emerge as a significant theme for the vast majority of SOE reports.

SOE reporting provides a critical perspective through its general focus on environmental conditions and their causitive factors. However, it is not a broad enough instrument to deal effectively with the human and ecosystem issues that are critical to the concept of sustainability. Insights must be drawn from a large number of other reporting perspectives. Each has something to offer, although no single one can deal with the breadth of topics requiring attention.

The Task Force on Reporting of Canada's National Round Table on the Environment and the Economy has called for explicit boundaries on SOE reporting in order to strengthen its position and to clarify the relationship between SOE reporting and reporting on sustainability. It suggests that "the appropriate span of SOE reporting is an assessment of: (1) ecosystem health or integrity; and (2) how and to what extent human activities stress or restore the ecosystem" (NRTEE, 1993). This definition would then put a broad assessment of human health, regional economic well-being, community well-being etc. outside the limits of SOE reporting. These topics must be dealt with by reporting on sustainability.

## CONCEPTUAL FRAMEWORK

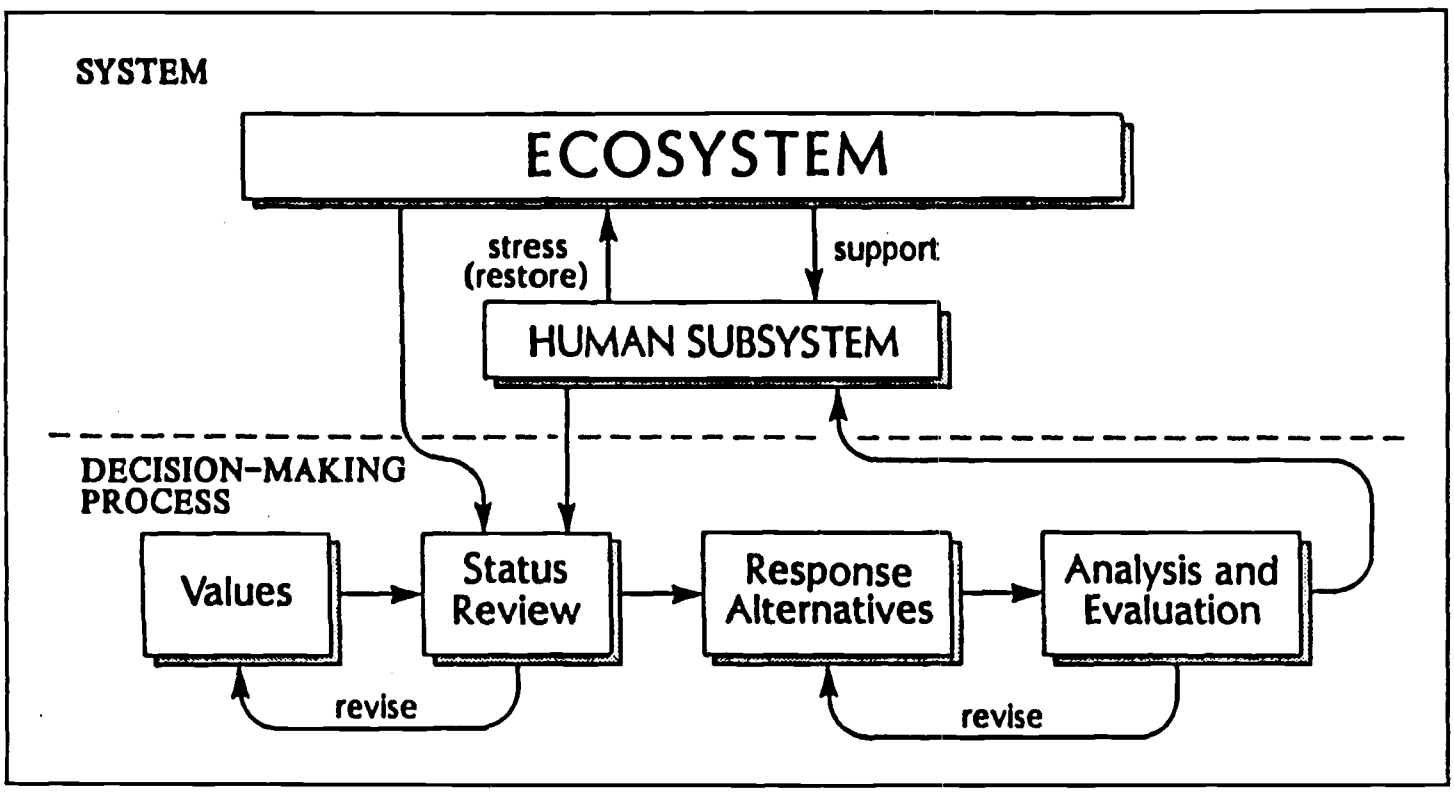
While never losing sight of the whole, systems analysis includes identification of the constituent parts as well as the relationship between those parts. The elements of the proposed conceptual framework emerge from:

- the value set reflected in Table 1;
- the review of the various theoretical treatments of the human-ecosystem relationship;
- practice demonstrated in the review of state-of-environment reporting as well as literature describing reporting on quality of life, health, economics, development, natural resource use.

Reporting is intended to meet the monitoring, assessment and evaluation requirements of decision-makers. Any system of reporting is necessarily part of a larger decision-making system.

Decision-making processes begin with an assessment of current status. This assessment is controlled by both available data and information, as well as by operating values that facilitate any judgement. Alternatives are then identified and weighed and a decision is made. Opportunities for revision are possible at several points in this decision-making process.

The proposed conceptual framework links decision-making with the ecosystem, the people, and their interaction. It is shown schematically in Figure 1.




*Sources: Hodge, in progress; Hodge and Taggart, 1992.*

**Figure 1. Conceptual framework.**

## LINKING THE CONCEPTUAL FRAMEWORK TO A REPORTING STRUCTURE

Macelli points out the inevitable link between the conceptual approach taken in any project and the format of the final report (1977). Thus, in practical terms, the application of Figure 1 results in a particular report structure that would be grounded in the following major domains of data and information:

**ECOSYSTEM**: the integrity, health, or well-being of the ecosystem;

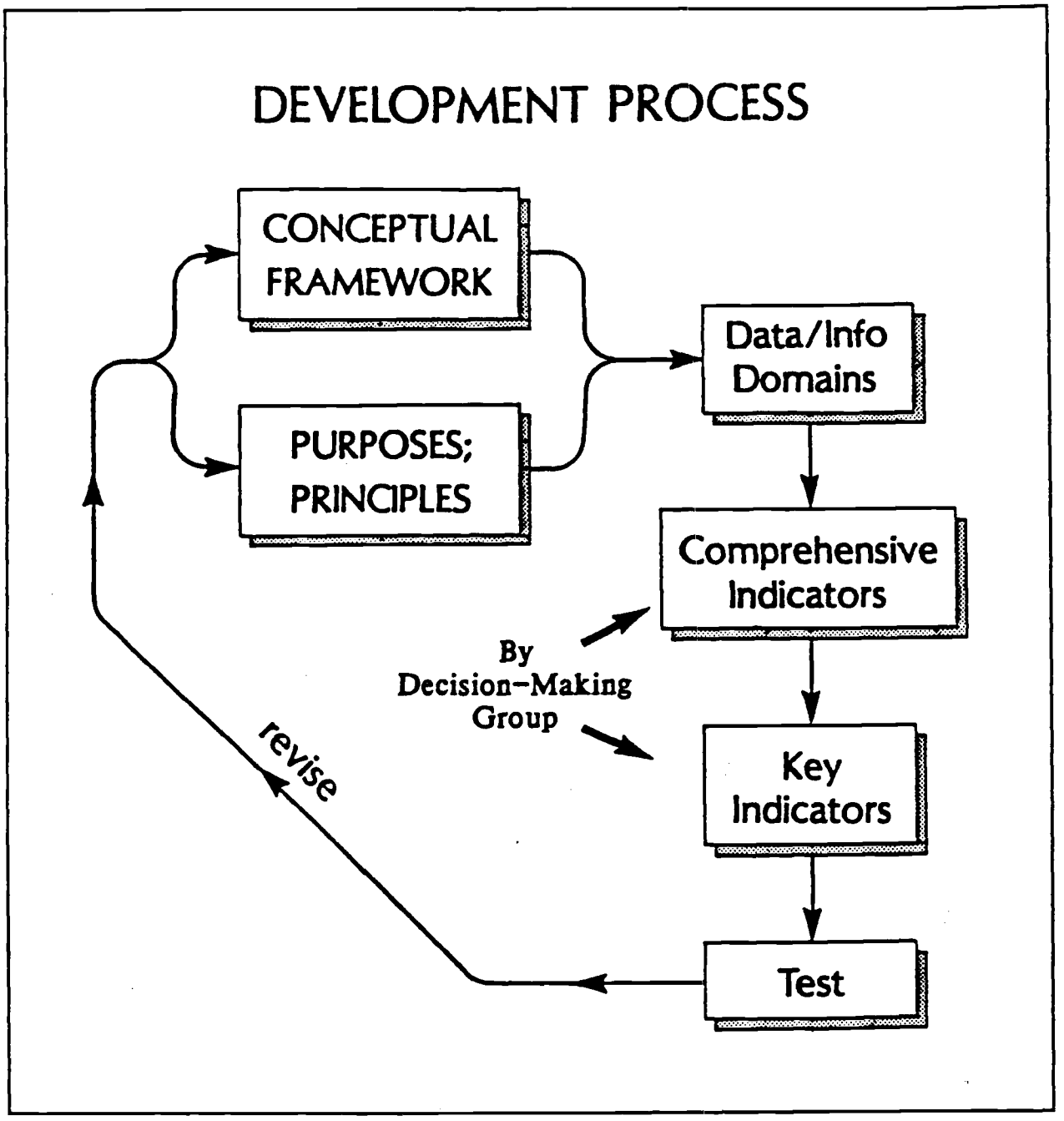
**INTERACTION**: the interaction between people and the ecosystem: how and to what extent peoples' actions contribute to the provision for basic needs and quality of life, how these actions stress or contribute to restoring the ecosystem; the rate of success at achieving standards and targets; and

**PEOPLE**: the well-being of people (individuals, communities, corporations, regions, provinces/states, nations, other decision-making groups) including the range of physical, social, cultural and economic attributes.

**SYNTHESIS**: key linkages across the above three components, assessment of the whole.

Each domain spans a complex set of data and information. Together they provide a template to be applied in order to consider the reporting needs of different decision-making groups.

With a reporting framework in place, it is then possible to turn to the indicators issue and begin the learning process that will eventually lead to a short-list of key indicators of sustainability. The developmental process is shown in Figure 2.




*Source: Hodge and Taggart, 1992; Hodge, in progress*

**Figure 2. Process for development of the system of reporting on sustainability.**

## REPORTING AS PART OF DECISION-MAKING

Ruitenbeek rightly emphasizes the fact that different decision-structures may have different information requirements (1991 b). He reviews the role of environmental information within eight different decision-making regimes that include those that are non-coercive (e.g. competitive market, voluntary exchange), coercive (e.g. benevolent dictator), democratic (majority rule and modifications), and others (e.g. structurally induced equilibrium).

In addition to these country-to-country differences, various groups of decision-makers within any one society are entrenched in different "cultures". These cultures are characterized differently in terms of needs, values, and motivation. Thus, "corporate culture" can be differentiated from, for example, "bureaucratic culture" which in turn is different from the culture of academics.

These internal cross-cultural differences are just as significant as those examined by Ruitenbeek above. The system of reporting on sustainability must be sensitive to these different "cultures" and tailored to the needs of different decision-making groups in order to be broadly applied. Thus, in western market-driven democracies, the following four decision-making groups are clearly of primary significance:

- individuals and households;
- corporations and corporate groupings;
- communities and settlements;
- regional, provincial/state and national governments

The choice is pragmatic although it may be seen as an extension (recognizing the role of communities) of the three components of the conventional model of the market economy which typically includes firms, households, and government (Hodge, in progress).

In other countries, this set of decision-making groups may not be appropriate. For example, in societies where tribes or clans predominate, their decision-making needs may transcend all of the above groupings. This topic requires careful examination.

# 4. MAJOR DOMAINS OF DATA AND INFORMATION

## DOMAIN 1: ECOSYSTEM

Ehrlich and Roughgarden point out that:

> An ***ecosystem*** consists of all the organisms in an area and the physical environment with which they interact (1987, p. 521).

Two important issues arise from this definition. One is ecosystem boundaries and the other is the choice of a classification system to deal with ecosystem components.

### The Boundaries Issue

Christie et al. explain that the term "ecosystem" has come to mean natural or artificial subdivisions of the biosphere whose boundaries arbitrarily defined to suit particular purposes. Thus they state:

> It is possible to speak of your personal ecosystem (you and the environment on which you depend for sunshine, air, water, food, and friends), the Great Lakes basin as an ecosystem (interacting communities of living and non-living things in the basin), or our planetary ecosystem, the biosphere (1986, p. 4 - 5).

It is important to note that ecosystems defined and/or bounded by ***natural*** characteristics (e.g. a drainage basin or forest limit) are rarely coincident with political jurisdictions or areas defined in law by ownership.

This lack of coincidence almost inevitably leads to discordance between ecosystem functions and the results of human decision-making. From a reporting perspective, this creates the need for "multiple boundaries", an approach that superimposes the area of the direct responsibility of the decision-maker (boundary 1) on the implicated ecosystems (boundaries "2 . . . n"). This system forces decision-makers to recognize and take responsibility for the ecosystem(s) with which they are connected.

The issue of the relationship between human activities in one jurisdiction and/or ecosystem and its implications on environmental and social conditions in other jurisdictions and/or ecosystems is a complex one. The effects of international trade on this already complex issue have only recently been given attention (see for example, WCED, 1987, Chapter 3). Reporting is pivotal to a large number of related issues including the international regulation of resource use, trade in endangered species, subsidies, environmental requirements in foreign investment,

transfer of environmentally friendly technologies, enforcement, and dispute resolution.

On a more local but equally critical scale, Rees has attempted to develop a methodology for calculating the "ecological footprint" of urban areas — that is, the extent of ecological carrying capacity of areas beyond urban boundaries that are implicated by urban activities (Rees, 1992).

## The Classification Issue

The simplest and most common classification of ecosystem components is listed in APPENDIX II. It is used in various forms in the majority of state-of-environment reports where for example, sections can be found addressing individual components of the ecosystem such as "water" or "air".

The use of a component type classification has been criticized as insensitive to ecosystem linkages, and driven by administrative convenience (Rapport and Friend, 1979, p. 74). Ecosystem defined areas such as river basins or terrestrial ecoprovinces are usually proposed as preferred alternatives.

However, a classification of ecosystem components is often confused with what is essentially a classification of ecosystem space. In practice, ecosystem components must be considered but that must be done within the context of the ecosystem being assessed. The classification shown in APPENDIX II is inadequate as a reporting framework. It would have to be used in conjunction with a systematic spatial framework that provides the needed linkages. However, different components of the ecosystem function within different spatial scales. Thus, no one spatial classification will ultimately resolve all spatial concerns.

A classification that provides a different perspective than those noted above has been developed by Robert Prescott Allen (IUCN, 1991, p. 34). He differentiated four ecosystem types:

1. **NATURAL**: since the industrial revolution (1750) human impact has (a) been no greater than that of any other native species, and has (b) not affected the ecosystem's structure;

2. **MODIFIED**: human impact is greater than that of other species but structural components are not cultivated;

3. **CULTIVATED**: human impact is greater than other species and most structural components are cultivated; and

4. **BUILT**: ecosystems dominated by human structures.

Prescott Allen's complete schema with notes is found in APPENDIX III.

## Assessing Ecosystem Health

A final topic to be addressed in the discussion of this domain relates to the ongoing debate on how and whether it is even possible to define and measure ecosystem health or integrity. Haskell et al. argue that indicators, endpoints, and parameters (with acceptable ranges) must be established in order to make such an assessments (1992, p. 7) . They also note that while many such variables have emerged in the ecological literature, there are significant impediments. Firstly, each ecosystem is unique and therefore must be assessed independently. Secondly, change causes ecosystem adaptation which demands that indicators be adequately robust in order to respond and finally, each scientist evaluating an ecosystem is likely to choose a different set of variables depending on his or her specific interest and expertise. In spite of these impediments, the fact is that decision-makers must come to grips with the issue of assessing ecosystem integrity. The topic is the subject of much debate and ongoing research (see Rapport, 1989; Costanza et al., 1992).

## DOMAIN 2 - INTERACTION

Human-ecosystem interaction is controlled by two sets of factors:

(1) natural conditions and events that set the conditions in which the human subsystem functions; and

(2) human activities which draw on the ecosystem for support, simultaneously impose stress, and in special cases, facilitate restoration of ecosystem functions.

Human decision-making processes cannot control natural conditions and events — ultimately, people do not manage the environment. However, people are fully responsible for the decision-making that does influence human activities which, in turn, affect the environment. Rapport and Friend correctly describe human activities as the motor or lever of the required information and reporting system (1979, p. 75).

Ideally, human activities would be classified and assessed in terms of their "value" (contribution to provision of basic needs and an enhanced quality of life) and by the physical, chemical, and biological stresses they impose on the ecosystem. Three limitations arise.

Firstly, a comprehensive activity classification that can serve as a basis for such an assessment does not exist. Secondly, current ability to value activities is limited and lastly, current ability to assess the physical, chemical, and biological stress imposed on the ecosystem by human activities is still in the earliest stage of development. Each of these is dealt with below.

## Classifying and Valuing Human Activities

The Standard Industrial Classification (SIC) is structured along activity lines and provides the organizational framework for the valuation of human activities (calculation of "value-added") that occurs through various countries' Systems of National Accounts (SNA). In principle then, they together provide a useful starting point for addressing the human activities issue. The following three observations support this tactical approach:

Firstly, the majority of human activities that are currently overstressing the environment are the activities driving the market system; the very activities described in the SIC. Secondly, data bases compiled on the basis of the SIC provides the most complete and long-term data series describing human activity available. Lastly, current societal decision-making commonly uses SIC categories. Their usage thus facilitates a link to decision-making.

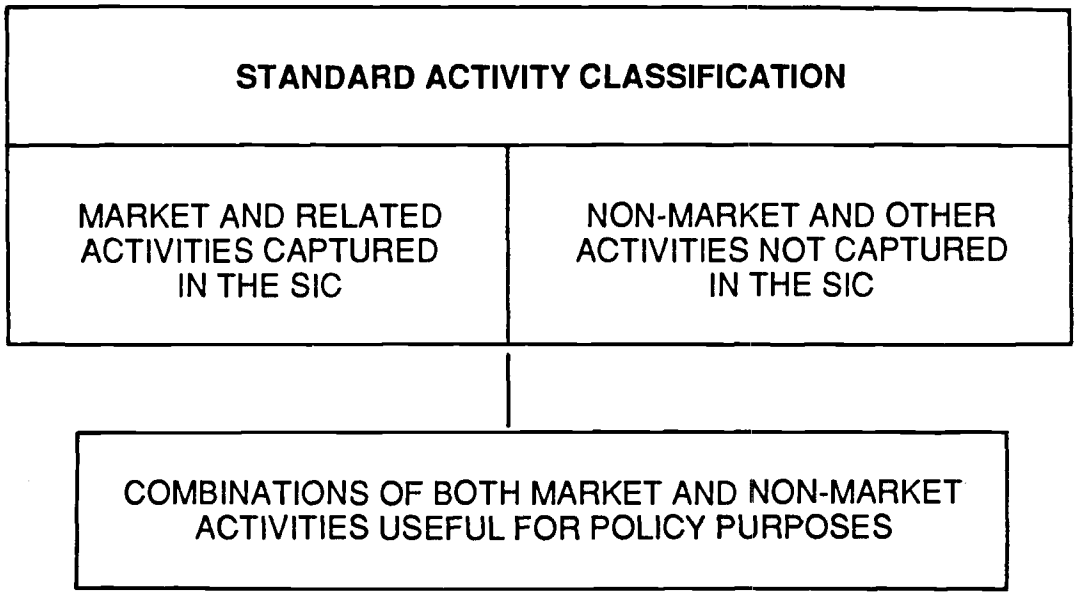
Several difficulties arise. Although the United Nations has attempted to bring standardization to the SICs used by different countries, significant differences remain.[5] Also, the SIC does not provide a complete classification of human activities. In addition to the market-driven or dollar-measured activities captured in the SIC, many others occur that both provide for human well-being and in the process, stress the supporting ecosystem. Included are (1) non-wage household and home operation, maintenance, and improvement; childcare and rearing (most of which is carried out by women)[6]; (2) voluntary activities[7]; (3) subsistence activities[8]; and (4) illegal/black-market activities.

It is important for policy purposes to consider a number of combinations of both market and non-market activities. Some obvious examples are:

- energy use and distribution;
- water use and distribution;
- tourism and recreation;
- generation of waste, accidents, and spills, etc.

Many of the above activities are studied by different groups of professionals who classify their data and information in ways that may or may not be compatible with the SIC. Thus, the lack of a common taxonomy of human activities impedes the integration of different data bases that contribute to current policy and decision-making.

To overcome the above concerns at least conceptually, the "STANDARD ACTIVITY CLASSIFICATION (SAC)" shown below in Figure 3 will be used in this project.




*Source: Hodge, in progress.*

**Figure 3. General framework for a Standard Activity Classification (SAC)**

The value-added of human activities, whether or not included in the Standard Industrial Classification, is almost always described in dollar terms and used as a surrogate for "value". In fact, this is a controversial topic. For example, in addition to money-based assessments of value-added, time-based (Waring, 1988), land-based (Lands Directorate, 1983), and energy-based (Susan Holtz, personal communication) valuation approaches have been suggested for human activities.

The rationale for these alternative approaches centres on the need to be more sensitive to the issues of ecosystem integrity and the distribution of social, environmental, economic, and cultural costs and benefits than is possible using contemporary macroeconomic analysis. This topic remains unresolved and a subject of current research. Unfortunately, while there is a substantial literature regarding the "value" of the environment, only a small body of research deals with the valuation of human activities, except as it relates to the pricing of market activities. This imbalance reveals a major gap in research.

## Stresses Imposed by Human Activities

Rapport and Friend make a major contribution by their introduction of a classification of human activities by imposed stress (1979). A modification of this classification is provided in Table 2, and in Table 3 the stresses are grouped as physical, chemical, or biological. It is this classification of stresses that will be used in this project as a check-list for analyzing human activities.

**Table 2. Naturally occurring and human-induced stresses experienced by the ecosystem.**

| Stress family | Activity example |
|---|---|
| 1. EXTREME NATURAL EVENTS | Weather related; wind, storms, rain, flooding drought, freeze-thaw cycles; naturally occurring forest fires in forests, grasslands, and marsh areas;<br><br>Disease, parasites, and other causes leading to natural population shifts. |
| 2. ADDITION OR LOADING OF SUBSTANCES, HEAT, RADIONUCLIDES, ETC. | Discharge of a vast range of chemicals to land, air, surface water, and groundwater including pesticides, industrial, municipal and transportation by-products and wastes,<br>carbon-dioxide, and other greenhouse gases, Chlorofluorocarbons that deplete stratospheric ozone;<br><br>Human induced erosion and deposition of sediments;<br><br>Discharge of phosphorous, nitrogen, and other nutrients that serve to fertilize plants and the primary trophic levels. |
| 3. PHYSICAL RESTRUCTURING AND LAND USE CHANGE | Damming, dyking, dredging, filling or other modifications of waterways and lakes;<br><br>Dhoreline protection (groins, seawalls etc.) and modification such as harbour construction;<br><br>Noise generation<br><br>Forest and bushland clearance for agriculture, industry, transportation corridor or settlement development; wetland drainage, excavation, and development;<br><br>Excavation, filling, clearing, or otherwise altering land areas. |
| 4. HARVEST OR EXTRACTION OF RENEWABLE RESOURCES | Water withdrawals (from surface water or wells), diversions, and consumptive uses;<br><br>Commercial forestry;<br><br>Fishing, hunting, trapping (subsistence, commercial, or recreational); |

| | |
|---|---|
| 5. **EXTRACTION OF NON-RENEWABLE RESOURCES** | Extraction of minerals and building materials; |
| 6. **INTRODUCTION OF NON-NATIVE SPECIES AND GENETIC MANIPULATION** | Stocking lakes with exotic fish species; unintended invasion of new aquatic species through canal construction, escape from aquaria, transport on boat or ships' hulls, in ballast water, etc.;<br><br>Intentional importation of plants, insects, birds, or animals;<br><br>Variety of "bio-technological" actions. |

*Source: Modified from Colborn et al., 1990; Regier, 1988; Francis et al., 1985; Rapport, 1983; Bird and Rapport, 1986; Rapport and Friend, 1979 (compiled in Hodge and Taggart, 1991, pp. 11-12.)*

**Table 3. Human activities grouped to show stresses as physical, chemical, or biological.**

| INDUCED STRESS "TYPE" | HUMAN ACTIVITY |
|---|---|
| **PHYSICAL** | • physical restructuring<br>• land use change<br>• erosion and sedimentation<br>• discharge of heat<br>• noise generation<br>• extraction of non-renewable resources |
| **CHEMICAL** | • discharge of chemicals |
| **BIOLOGICAL** | • harvest of renewable resources<br>• various forms of habitat disruption<br>• accidental or planned introduction of non-native species<br>• biotechnological manipulation |

*Source: Hodge, 1991, p. 16.*

The stresses listed in Tables 2 and 3 are usually imposed simultaneously and in an interlinked manner, making identification of specific causes and effects virtually impossible except in rare cases. The uncertainty caused by this lack of cause-effect link must be seen as a characteristic of contemporary decision-making, rather than an impediment (see Table 1).

The ecosystem itself integrates the effects of many simultaneously-induced stresses and it is to the ecosystem that we must turn for assessing cumulative effects. These conclusions underlie the power of bioindicators.

Systematically identifying and assessing specific stresses induced by human activity is relatively straight forward. However, while it is the focus of environmental impact assessments for new projects, it is not a practice typically applied to everyday human activities.

The desire to actively pursue options for stress reduction in day-to-day life is exploding. This desire is reflected in:

- adjustments to legislation aimed at encouraging improved industrial practices (variety of incentives including for example, increased penalties for non-compliance, changes to tax regimes and subsidies);
- changes to criteria for liability insurance for corporations and, in particular, Boards of Directors related to potential environmental problems;
- changes to corporate disclosure requirements related to the rights of investors, shareholders and the general public to know the environmental implications of corporate activities;
- changes in the lending criteria of the financial services industry forcing recognition of potential environmental liabilities;
- overall changes in corporate policy bringing environmental values to the forefront of decision-making (reflected in an array of activities from procurement policy through product greening, plant operational procedures, and altered design criteria);
- programmes throughout society in pursuit of the 3 R's (reduce, reuse, recycle);
- programs of energy conservation;
- the expansion of environmental programs in formal educational curricula.

Nowhere is the need to come to terms with stress on the ecosystem more apparent than in the international arena. As MacNeill et al. point out, in addition to the 1989 net transfer of over $50 billion from developing countries to the richer nations, a massive transfer of the environmental costs of the world's generation

of material wealth is taking place from the richer nations to the developing countries. In 1980, these costs were conservatively estimated at $14 billion and the situation has since grown much worse (1991, p. 21).

Assessing individual human activities on the basis of physical, chemical, and biological stresses provides a simple and comprehensive approach to stress assessment. It is combined with consideration of (1) the support provided by the ecosystem, (2) the value of resulting human activities in providing for basic needs and supporting an enhanced quality of life, and (3) the imposed physical, chemical, and biological stresses in an overall assessment of human-ecosystem interaction. Such a balance is somewhat analogous to but more complex than, a benefit-cost analysis.

One way of looking at stress is to use an analogy to the three-part, double threshold process of the stress - strain relationship used in solid mechanics. At low levels of applied cumulative stress, ecosystem change is reversible. After the first threshold, change (strain) in increasing amounts is permanent until a second threshold is reached and catastrophic failure occurs.

This model is appealing because it corrects a misconception that defines stress as "perturbation with negative effect on the system" (Costanza, 1992). Rather, low levels of applied cumulative stress may not necessarily be "bad": the ecosystem can deal with at least some perturbation. If, in fact, as some suggest, human health is an applicable analogy to ecosystem health (Rapport et al., 1981; Rapport, 1989) a small amount of stress may even lead to an invigorated ecosystem. This concept of stress is also consistent with Holling's idea that ecosystem health may be tied to an ecosystem's ability to use stress creatively more than to its ability to resist it completely (Holling, 1986, 1992).

Progress on tracking chemical stresses is being made as Waste and Pollutant Output Satellite Accounts are developed as part of Systems of National Accounts. In addition, the U. S. Toxic Release Inventory (TRI - operational since 1987) and, in Canada the National Pollutant Release Inventory (NPRI - initiated in 1993) are serving to dramatically increase the understanding of chemical emissions. Similar tracking of physical and biological stresses does not yet exist.

## Restoration

A last comment in this domain is that a growing human effort is aimed at consciously reducing stress and taking actions to facilitate restoration of ecosystem functions. These activities also require recognition within the reporting system. Interestingly, increased interest in restoration ecology as a science is reflected in the existence of a learned society, The Society for Ecological Restoration, which publishes a biannual journal, ***Restoration and Management Notes***. A summary of many of the main ideas of restoration ecology is provided in CBC (1992).

## DOMAIN 3 - PEOPLE

People and their well-being are the subject of this domain: individuals, families, communities, cities, tribes, corporations, regions, provinces, territories, states, nations or whatever grouping is important in terms of decision-making.

While objective measures of the physical and material well-being of individuals and families have long been gathered, more recently psychologists and sociologists have been assessing people's "subjective well-being" — their feelings of happiness, their sense of satisfaction with life (Myers, 1992). This domain spans these complex topics.

APPENDIX V provides a list of the types of topics that might be included in a comprehensive assessment of human well-being. This list is compiled from health, quality of life, human development and healthy cities literature. It would be modified significantly depending to which decision-making group this assessment was being applied.

In order to overcome the difficulty of assessing human well-being on the basis of all the components listed in APPENDIX V, the United Nations Development Program (UNDP) has proposed the use of a human development index (HDI). The HDI is based on three components: (1) longevity measured by life expectancy at birth; (2) knowledge measured by literacy (weighted two-thirds) and mean years of schooling (weighted one-third); and (3) income (adjusted on the premise of diminishing returns with increasing income relative to the poverty line). Where data are available, the HDI is calculated to test differences in gender, income distribution, ethnicity, and urban-rural characteristics (UNDP, 1993).

Effectively assessing the well-being of people - individually and collectively - may be the least well understood component of the entire spectrum of reporting on sustainability.

## SYNTHESIS, NUMBERS, AND JUDGEMENT

Undertaking a synthesis and making a judgement about current state, contributing factors, and implications of trends, is an essential step. At this point a sense of the whole must once again be sought.

Further, it is at this step that anticipatory thinking must be applied. Three broad approaches can be used: (1) attempting to predict over the short-term; (2) building, testing, and preparing for a range of alternative scenarios that might incur in either the short or long-term; or (3) backcasting — working back from future desired states to identify policies and actions needed today to achieve those states (see discussion in Hodge, in progress).

Such an assessment is invariably value laden. In some cases, contributing factors may be numerically expressed; in others this may not be possible. In some cases standards based in regulation or law may be applicable; in most cases such a regime does not exist. Sometimes science may have provided an "objective standard" but often no such measuring device exists. In rare cases, public discussion may have led to the establishment of "benchmarks" against which progress can be measured. In general, those undertaking a synthesis and overall assessment will have to depend upon their own judgement.

However, it is critical that any judgement be accompanied by a clear statement that provides supporting rationale. There is a direct analogy to our courts and the discharge of common law. Given "reasons-for-a-decision", there is opportunity for public discussion. Further, new information can be recognized and any judgement modified accordingly. Without an expression of rationale, any assessment is largely wasted.

Lewis Mumford notes that the introduction of the clock and regular measurement of time marked the first application of quantitative methods of thought to the study of nature (1934, pp. 324 - 330). He links the change in time perception to a parallel shift in the conception of time in which "space as a hierarchy of values was replaced by space as a system of magnitudes". He argues that with this shift, all events were then seen within the context of this new ideal structure of space and time. In summary, he points out:

> The new attitude toward time and space infected the workshop and the countinghouse, the army and the city. The tempo became faster; the magnitudes became greater; conceptually, modern culture launched itself into space and gave itself over to movement. What Max Weber called the "romanticism of numbers" grew naturally out of this interest. In time-keeping, in trading, in fighting, men counted numbers; and finally, as the habit grew, only numbers counted. (p. 332)

There is power and confidence in numbers and the generation of the right numbers is an essential task. However, numbers are not the ultimate goal. Even without numbers, qualitative information can often facilitate good judgement. Furthermore, in many instances of assessing progress towards sustainable development, numbers simply will not be available. However, provided rationale that facilitate public review is given, a qualitatively based judgement may be just as useful as one steeped in numbers.

# 5. DECISION-MAKING GROUPS

## INDIVIDUALS AND HOUSEHOLDS

Individuals and households are the fundamental decision-making units of most societies. Personal and household decision-making regarding reproduction, food, housing (purchase, rental, operation, maintenance), transportation, clothing, recreation, and the broad range of other consumer activities all have major implications for stressing the environment as well as providing for basic needs and supporting a desired quality of life. The exact nature of these activities varies widely from culture to culture.

Using the reporting structure proposed earlier as a template, the kinds of information listed in Table 4 emerge as important to include in reporting ***to the individual or householder*** in support of improved decision-making.

**Table 4. Reporting elements: individuals and families.**

**ECOSYSTEM INTEGRITY (NATURAL, MODIFIED, CULTIVATED, BUILT)**

- ecosystem well-being: state/quality of home, workplace, neighbourhood and community and assessment of the impact that state has on the individual and family; comparative data to allow comparison with others

**INTERACTION**

- activity stress assessment (physical, chemical, biological); data to allow comparison with others
- identification of opportunities for stress reduction, success at doing so
- opportunities for and success at restoration

**PERSONAL AND FAMILY WELL-BEING**

- personal and family well-being
- profile and valuation of personal and family activities

**SYNTHESIS**

- links across the above; assessment of the "whole"; anticipatory assessment

## CORPORATIONS AND CORPORATE GROUPINGS

The corporate universe is diverse. Elements include for-profit corporations, not-for-profit voluntary organizations, professional associations, cooperatives, hospitals, unions, universities, and colleges. Strictly speaking, government also functions as a "corporate" entity. However, because of its special status as society's rule maker, it is considered separately.

Financial viability and employee safety are the traditional focus of for-profit corporate reporting. Reports have been targeted at shareholders and investors, senior management, the board of directors, employees, and customers. Many of these reporting elements are controlled by law.

Over the past three years, for-profit corporate leaders have adjusted reporting procedures. They have expanded both the list of stakeholders that are targeted for receipt of information to include host communities and the value base that drives the reporting process to include environmental and ethical concerns. Social, environmental, ethical, and procurement issues have been added to traditional reporting topics.

Motivation for this shift has been (1) expanding environmental and ethical awareness; (2) tightening environmental standards at all levels including local, regional, national, and international; and most importantly, (3) a shift in stance of the Financial Services Industry and its recognition of long-term liability particularly related to contaminated land and groundwater systems (see Cassils, 1993).

The proportion of total for-profit firms reporting in this new way is small but growing (probably than .5 percent). Other elements of the corporate universe that do so are rare exceptions.

## Table 5. Reporting elements: corporations and corporate groupings.

**ECOSYSTEM INTEGRITY (NATURAL, MODIFIED, CULTIVATED, BUILT)**

- assessment of the health and integrity of the ecosystem with which the corporation has interaction.

**INTERACTION**

- activity stress assessment (physical, chemical, biological); comparative data to allow comparison with other corporations
- identifications of opportunities for stress reduction, success at doing so
- opportunities for and success at restoration
- record of compliance with laws and regulations

**WELL-BEING**

- corporate well-being (financial and otherwise)
- profile and valuation of corporate activities (benefits contributed to shareholders, employees, community etc.)
- well-being of the community with which the corporation interacts

**SYNTHESIS**

- links across the above; assessment of the "whole," anticipatory assessment

## COMMUNITIES AND SETTLEMENTS

Daly and Cobb point out that a society can be called a community if:

(1) membership in the society contributes to self-identification;

(2) there is extensive participation by its members in the decisions by which its life is governed;

(3) the society as a whole takes responsibility for its members; and

(4) this responsibility includes respect for the diverse individuality of these members.

(Daly and Cobb, 1989, p. 172)

By this definition, ethnicity, tribe, gender, religion, interest, geography, or political jurisdiction could be motivation for a community. However, in western market economies, community level data and information are usually grouped on the basis of a local government of some type. Statistics describing aboriginal groups may be an exception to this - as Land Claims are addressed, aboriginal self-government is more and more considered a fourth level of government. In less developed countries, the organizational basis of information systems often stems from colonial periods and may not reflect current needs or be compatible with information systems elsewhere. This topic requires further research.

From a reporting perspective, any government, local or otherwise, has a twofold reporting responsibility:

1. reporting to the electorate on its performance as a corporate entity; and

2. monitoring and assessing the well-being of the people, the nature of the human-ecosystem interaction, and the integrity of the ecosystem within its jurisdiction;

The first category is no different in principle than the corporate reporting described above and should include the elements listed in Table 5. Category two reporting on sustainability would include the elements listed in Table 6.

## Table 6. Reporting elements: communities and settlements.

**ECOSYSTEM INTEGRITY (NATURAL, MODIFIED, CULTIVATED, BUILT)**

- assessment of the health and integrity of the ecosystem with which the community has interaction

**INTERACTION**

- activity stress assessment (physical, chemical, biological); comparative data to allow comparison with other communities
- identifications of opportunities for stress reduction, success at doing so
- opportunities for and success at restoration
- record of compliance with laws and regulations

**COMMUNITY WELL-BEING**

- the well-being of community members and how that compares to other communities;
- profile and valuation of community activities

**SYNTHESIS**

- inks across the above; assessment of the "whole", anticipatory assessment.

## REGIONAL, PROVINCIAL/STATE AND NATIONAL GOVERNMENTS

In addition to reporting to the electorate for its performance as a corporate entity (Table 5), reporting on sustainability for this group of decision-makers should ideally include the elements listed in Table 7.

**Table 7. Reporting elements: regional, provincial/state, and national governments.**

**ECOSYSTEM INTEGRITY (NATURAL, MODIFIED, CULTIVATED, BUILT)**

- assessment of the health and integrity of the implicated ecosystem

**INTERACTION**

- activity stress assessment (physical, chemical, biological); comparative data to allow comparison with other communities
- identifications of opportunities for stress reduction, success at doing so
- opportunities for and success at restoration
- record of compliance with laws and regulations

**WELL-BEING**

- overall assessment including that of individuals, corporations, corporate groupings, regions, provinces and the nation as a whole; how that compares to others;
- profile and valuation of activities

**SYNTHESIS**

- links across the above; assessment of the "whole", anticipatory assessment

## INTERNATIONAL AGGREGATES AND COMPARISONS

Calculation of international aggregates and the use of comparative figures from country to country is complex matter given the potential for the values of one country or culture to be imposed inadvertently upon another, the differences in statistical definitions from country to country, and the huge variation in the availability and quality of data and information. The complexity of this issue should not be underestimated.

# 6. LINKS TO AGENDA 21

The United Nations Conference on Environment and Development (Earth Summit) was held in Rio de Janeiro, Brazil, June 8-14, 1992. The concept of sustainable development, championed in the report of the World Commission on Environment and Development five years earlier (WCED, 1987), was the central theme. Five documents resulted:

- AGENDA 21, an overall framework for follow-up action from the conference;
- The Rio Declaration on Environment and Development;
- A Framework Convention on Climate Change;
- A Convention on Biological Diversity
- A non-legally binding statement of principles on themanagement, conservation, and sustainable development of forests.

AGENDA 21 provides an overview of the conference outcome. The macrostructure of AGENDA 21 is given in APPENDIX VI as is a listing of the same elements grouped on the basis of the proposed framework. Several initial observations emerge from a review of APPENDIX VI.

Firstly, AGENDA 21 has not emerged from any sort of systematic treatment of human-ecosystem interactions, it is rather a treatment of current issues of concern. As a result, the organization of AGENDA 21 does not encourage anticipatory thinking of the nature advocated by the World Commission on Environment and Development (WCED, 1987).

A second observation is that not all components of the earth's ecosystem receive attention in AGENDA 21. Thirdly, AGENDA 21 does not assume an approach to human activities that attempts to balance the value of these activities with the stress they impose upon the ecosystem. There is discussion of integrating environmental and economic accounting (Chapter 8) and adding natural resource satellite accounts to national accounts (Chapter 40), but the implicit value set underlying the SNA is not recognized. Lastly, while there is discussion about broadening participation in decision-making and various sub-populations are identified and discussed, there is no recognition of either the different groups of decision-makers within any society or of the differences between various societies.

Given these limitations, AGENDA 21 does not provide an adequate framework for a reporting system for assessing progress towards sustainable development or sustainability in general. Nevertheless, AGENDA 21 does provide an important check list of current issues that must be dealt with by the needed reporting system.

# 7. INDICATOR DEVELOPMENT

The approach taken in this document is to work from the most general to the specific - from the whole to its components and back again. Each of the major domains of data and information implicates different areas of knowledge and expertise. And within each domain, specific indicators are required to meet the needs of any given decision-making group.

To understand ecosystem conditions and processes, a range of natural sciences including ecology, biology, zoology, entomology, botany, geology, must be brought together with country knowledge.

Other areas of expertise are required to treat human-ecosystem interaction. This analysis, however, must be driven by human activities and it is here that the power of economics must be applied. Analysis of the interface will also draw on a range of applied, natural and social sciences, and law.

In addition to the traditional health professions, many other disciplines are involved in defining and understanding human well-being (NRTEE, 1993). Philosophy, religion, and practical ethics lay claim to being the very foundation of well-being. The various branches of psychiatry, psychology and sociology are interested in individual personality and the health of the individual-family-community relationship. For many years, landscape architecture and land use planning have been involved in systematic attempts to understand individual, household, and community well-being in relationship to characteristics of the physical and social environment. Much of this is captured in quality-of-life literature. Assessing the well-being of corporations requires yet other areas of expertise.

Integration and synthesis is an interdisciplinary task. Geographers, planners, engineers, and ecologists are all implicated. In practice, the system must be simplified in order to allow the generation of meaningful results in spite of resource limitations.

However, it is the needs of each decision-making group that must drive indicator development in any given domain. Without this approach, indicator development becomes at best, a haphazard process. Given that this systematic approach -- which begins with the general before moving to the specific -- has never been applied within the context of sustainable development, it is not surprising that previous efforts to develop new indicators have met with little success. Given time, new indexes like the human development index can evolve. These indexes would allow the integration of a spectrum of interests.

Tables 3 through 6 demonstrate a hierarchy of data and information. In order to bring some semblance of order to a very complex system, it is essential to start from the very general and work to the specific. Thus, with each developmental cycle (Figure 2, p. 12), specific measures are the last, rather than the first to address.

# 8. PRODUCT(S) AND TESTING METHODOLOGY: INITIAL THOUGHTS

A number of regular reports currently address conditions in both developing and developed parts of the world. These include:

- UNDP's ***Human Development Report*** series;
- UNEP's ***State of the World Environment*** and ***Environmental Data Report*** series;
- UNICEF's ***State of the World's Children*** series;
- UNESCO's ***World Education Report*** series;
- the World Bank's ***World Development Report*** series;
- The World Resources Institute's (with UNEP and UNDP) ***World Resources*** series;
- The Worldwatch Institute's ***State of the World*** series;

Each of these contributions provide critical input towards understanding the nature of progress in today's world. But no one of them draws together all the elements that are the building blocks of assessing progress towards sustainable development. Thus, an integrating mechanism that builds on and complements existing reports is needed.

The conceptual framework proposed in this paper (Figure 1, p. 10) and the generic, four-part reporting structure that emerges (p. 11) are together intended to provide the overall integrating mechanism as well as to be the focus of testing in Phase 2. Specifically, each major domain needs testing and the integrated whole must be applied to address the needs of different decision-making groups in both developing and developed regions.

Provided that the question of feasibility is positively assessed, the following will have been achieved by the end of Phase 1:

1. general agreement on the proposed conceptual framework for guiding the reporting system;

2. identification of a network of potential contributors and partners and how they might best be linked to Phase 2; and

3. identification and assessment of alternative "products" that could be included in the resulting reporting system for both the immediate and the long-term.

Test cases for the reporting system will be defined by country, region, community, or any other particular decision-making group. The generic four-part reporting structure will be used to drive Phase 2 testing. The choice of partners will be based on maximizing the use of limited resources, opportunities for building on existing IDRC projects where possible, and seeking variation in the following factors:

1. **ECOSYSTEM CONDITIONS AND BOUNDARIES:** range of both ecosystem types and conditions;

2. **PEOPLE** AND **DECISION-MAKING**: range of human conditions; cultures, political systems, and decision-making groups in play;

3. **HUMAN ACTIVITY AND IMPOSED STRESS**: range of the type and level of human activities and imposed stress on the ecosystem;

4. **JURISDICTIONS**: variation in aerial extent and population; use of both jurisdictions spanning ecosystems as well as those whose boundaries coincide with ecosystem boundaries; and

5. **DATA/INFORMATION AVAILABILITY**: range of available objective and subjective data and information.

## 9. SUMMARY COMMENTS

The proposed conceptual approach is intended as a roadmap to facilitate participation by the many interests who rightfully claim a share in the ideas of sustainable development and sustainability. For this reason, while existing disciplines are drawn upon (e.g. ethics and religion, ecology, economics, geography, health sciences, sociology, political science, law, information sciences), the conceptual approach consciously avoids discipline specific labels.

This approach is not, for example, an "economics" approach although it depends upon the analytic power of economics to assess human activities. Similarly, it is not an "ecology" approach yet it cannot succeed without the insight of ecologists. Nor is it fundamentally driven by health sciences, sociology, political science, or law although each discipline plays a critical role.

The conceptual framework proposed in this paper is motivated by theory, practice, and values. It leads to identification of a four-part generic reporting structure. This structure provides a template to address the needs of various decision-making groups which are characterized by different values, motivations, and needs. A reporting system is, after all, a sub-system of the broader decision-making system (Figure 2, p. 12).

Reporting elements important to each of four decision-making groups central to western economies are listed in Tables 3 through 6. These tables reflect the breadth and complexity of data and information that would ideally be required. One reason for taking this approach is to explore whether or not elements of data and information exist that are common to two or more of the decision-mak-

ing groups. In practice, it is essential that every effort be made to avoid duplication within an information system.

Decision-making groups in non-market and developing countries may well be significantly different than the four groups highlighted in this paper. These differences must be identified, assessed and then used to modify the reporting system to suit the needs of those decision-makers.

The issue of data and information availability is critical. In practice, the initial challenge will be one of linking with existing sources of information rather than of developing new ones. Capacity building with partner countries will be a primary task.

## TEXT NOTES

1. There are alternative definitions of an "indicator". Ott (1979) uses the term to describe a mathematical function based on one variable while an "index" is based on two or more variables. The US Environmental Protection Agency defines an environmental indicator as "a characteristic of the environment that, when measured, quantifies the magnitude of stress, habitat characteristics, degree of exposure to the stress, or degree of ecological response to the exposure" (USEPA, 1990).

   In contrast to these two definitions, the Norwegians describe an indicator as a figure used to give a picture of changes in a specifically defined condition - it indicates broad outlines (CBS, 1992). Thus, a more qualitative sense is introduced. Environmental indicators such as emmission levels/GNP (OECD, 1991) or per unit of energy consumed (Environment Canada, 1991) fall within the Norwegian definition of indicator but would be indexes by Ott's definition.

   Bioindicators extend the sense of integrating many variables farther (Jeffrey and Madden, 1991). There is growing use of the term indicator in an even broader qualitative sense. For example, human well-being may be an indicator of ecosystem health, or conversely, ecosystem health may be an indicator of human well-being.

   In this project, the broader Norwegian definition will be used. Further, this project recognizes that quantitative measures are limited in their ability to describe many important qualitative characteristics. Thus, it is committed to supplementing quantitative data with information derived from qualitative inquiry (see discussion, YUCHS, 1990, p. 7).

2. Variously labelled sustainable equitable development, environmentally sustainable economic development, environmentally sustainable socio-economic development, ecologically sustainable development, and ecologically sustainable economic development.

3. Hodge, in progress.

4. Taken from Hodge, in progress. Earlier versions of this table are found in Hodge and Taggart (1992, pp. 19, 20) and Hodge (1991, pp. 78, 79). The following contributions were particularly influential:

   - BCRTEE, 1993a,b,c
   - Capra, 1982

- Conservation Council of Ontario, 1989
- Dorcey, 1991a,b,c
- Gardner and Roseland, 1989, Parts I and II
- Goldberg, 1989
- Holling, 1978
- IUCN et al., 1980; 1991
- Kidder, R., Personal Communication, 1993.
- MacNeill et al., 1991)
- NTFEE, 1987
- NRTEE, 1990, p. 7, 1992
- the mission statement of the National Round Table as stated in Article 4 of Bill C-72, *An Act to Establish the National Round Table on the Environment and the Economy*;
- OCHS, 1993
- ORTEE, 1991
- Ruitenbeek, 1991 a and b
- Schumacher, 1973
- WCED, 1987
- YTG, 1988, 1990

5. This relates partly to differing needs from country to country and partly to the fact that there is more than one criteria that can govern activity description. For example, many industrial activities can be described equally well by the product they produce as by the process they use. The choice is equally valid and varies from country to country.

6. The value of these activities may be as high as 53 % of GNP (Adler and Hawrylyshyn, 1978; Waring, 1988) although a more common estimate is roughly one-third (Burns, 1975) and recent work in Canada suggests a range of 32 - 39 percent (Jackson, 1992);

7. For example, estimates for Canada indicate that in 1986/87, 5.3 million Canadians (about 20 percent) were involved with volunteer work which was valued at $12 billion using an average service sector wage (Ross, 1990).

8. The social and economic significance of subsistence activities varies dramatically from country to country and from rural to urban areas.

# APPENDIX I

## MODELS REVIEWED BY HODGE (IN PROGRESS) THAT ADDRESS THE HUMAN-ECOSYSTEM INTERFACE

| MODEL | REFERENCE |
|---|---|
| **1. The Common "Social-Economic-Environment" Model** | |
| • Firey's Theory of Natural Resource Use | Firey, 1960 |
| • Sadler's Work on Sustainable Development | Sadler, 1988, 1990 |
| • Dorcey's Work on Sustainable Development | Dorcey, 1991a,b,c |
| • The British Columbia Round Table's Approach to Reporting on Sustainability | BCRTEE, 1992, 1993 |
| • The Prairie Farm Rehabilitation Administration's model of Sustainable Community Development | PFRA, 1992 |
| • The Canadian International Development Agency's Framework for Sustainable Development | CIDA, 1991 |
| **2. Health Variations of the Three-Part Model** | |
| • Hancock's Healthy Community Model | Hancock, 1989, 1990; Crombie, 1991 |
| • The Canadian Institute for Advanced Research's Model of the Determinants of Health | Evans and Stoddart, 1990 |
| • The Canadian Medical Association's Model of Sustainable Development | CMA, 1991 |
| • A System of Health Statistics for Canada | NTFHI, 1991 |
| • Steering Committee on Indicators for a Sustainable Society | Gosselin et al., 1991, 1993 |

### 3. Drawing From Economics

| | |
|---|---|
| • The conventional circular model of the market economy | Parkin and Bade, 1991 |
| • The Materials - Energy Balance Model | Kneese et al., 1970<br>Freeman III et al., 1973 |
| • The Pollution - Depletion Model | Tietenberg, 1992; Siebert, 1981; Kneese and Bower, 1979; Young, 1992; Manning, 1990; Leeman and Cox, 1990 |
| • The Population Economy Process Model | Hamilton, 1991 |

### 4. Stress-Response Ideas

| | |
|---|---|
| • Stress on People from Natural Events | Kasperson, 1969 |
| • Rapport and Friend's Concept of Stress-Response | Rapport and Friend, 1979; Friend and Rapport, 1989; Friend and Rapport, 1990; Friend, 1991 |
| • OECD's Pressure-Response Approach | Pearce and Freeman, 1992; OECD, 1993 |

### 5. General Ecological Models

| | |
|---|---|
| • Dansereau's Ecosystem Model | Dansereau, 1975, 1976, 1990 |
| • Miller's General Theory of Living Systems | Miller, 1978 |

### 6. Additional Analyses for Sustainability

| | |
|---|---|
| • The Sustainable Society Project | Robinson, 1989, 1991 |
| • World Conservation Strategies I and II | IUCN et al, 1980, 1991 |
| • Hill's Model of the Theory and Practice of Sustainable Development | Hill, personal communication, 1989 |
| • Nault's Analysis of Farm System Health | Nault, 1991 |

**7. AGENDA 21 Macrostructure** — UNCED, 1992

**8. Miscellaneous Contributions**

- Isard's Approach to Regional Analysis — Isard, 1960
- Easter et al.'s Watershed Analysis — Easter et al., 1986
- Stankey's Carrying Capacity Model — Stankey, 1972
- Application of the Medicine Wheel as Conceptual Guide for Aboriginal Development — DIPSC, 1991
- Society and Environment — de Haes et al., 1991
- CMHC's Conceptual Framework of Quality of Life — Murdie et al., 1992

## MAIN CONCLUSIONS

1. **NO EXISTING MODEL EMERGED THAT COULD SERVE AS A FRAMEWORK FOR REPORTING ON SUSTAINABILITY.** No one of these models rigorously and systematically describes the ecosystem and its relationship to the human sub-system in a way that lends itself to broad application in support of improved decision-making. It is apparent that any discipline specific model is unlikely to provide the needed framework. For example, economics derived models have evolved from a conventional circular model through a material-energy balance model to a now dominant, depletion/pollution model. While this latter model is encouraging consideration of some important environment-economy relationships, it inadequate for dealing with the broad range of physical, chemical, and biological stress imposed by human activity on the ecosystem. Further, its portrayal of the nature and role of the ecosystem itself is incomplete.

2. **ALMOST ALL OF THE MODELS REVIEWED OFFER USEFUL INSIGHTS FOR THE NEEDED CONCEPTUAL FRAMEWORK AND REPORTING SYSTEM.**

3. **MANY FACTORS ARE AT PLAY THAT MUST BE TREATED SYSTEMATICALLY IF CONFUSION IS TO BE AVOIDED.** Definitional clarity is critical regarding system components, relationships between components, and processes at play within or influencing the system.

4. **THE ECOSYSTEM, THE HUMAN SUBSYSTEM, AND THE INTERFACE BETWEEN THE TWO, ARE THE PRINCIPAL SYSTEM COMPONENTS THAT ARE COMMON AMONGST THE MODELS REVIEWED.**

5. **FEW OF THESE MODELS ARE FOUNDED ON AN EXPLICITLY BALANCED CONCERN FOR BOTH PEOPLE AND THE ECOSYSTEM.** Some of the models emphasize human well-being, while others focus on the health or integrity of the ecosystem. Only the work of

Easter et al. (1986) aimed at watershed resource management and Stankey's (1972) framework for wilderness management based on ecological and sociological carrying capacity seem to strike this balance. At a project level, recognition in the early 1980s of the need for both environmental impact assessment and social impact assessment within an "ecological framework" is a significant precursor (Beanlands and Duinker, 1983).

6. **SURPRISINGLY LITTLE EFFORT HAS BEEN DIRECTED AT SYSTEMATICALLY EXAMINING THE BROAD RANGE HUMAN ACTIVITIES AND THE ROLE THEY PLAY AT THE HUMAN-ECOSYSTEM INTERFACE.** Human activities and how they draw from the ecosystem and in turn impose stress are the dominant factor that can be managed and controlled by human decision-making. A systematic treatment of human activities is therefore critical for reporting on sustainability. Hill's model of the Theory and Practice of Sustainable Development rightfully centres on human activities and Isard's work on regional analysis also deals systematically with human activities. Rapport and Friend's (1979) description of both human activities and human imposed stress on the ecosystem stands as a major contribution.

7. **ASSESSING PROGRESS TOWARDS SUSTAINABILITY WILL INEVITABLY INCLUDE SUBJECTIVE JUDGEMENT** and balancing competing factors that may well contradict each other.

8. **VALUES PLAY A CRITICAL ROLE AND MUST BE TREATED EXPLICITLY.**

# APPENDIX II

# STANDARD CLASSIFICATION OF ECOSYSTEM COMPONENTS

## I. AIR AND CLIMATE

- outdoor air quality (including ozone depletion)
- indoor air quality
- atmospheric radiation
- climate change

## II. INLAND SURFACE WATER

- hydrology and water quantity
- surface water quality
- bottom sediments

## III. GROUNDWATER

- hydrogeology and water quantity
- groundwater quality

## IV. MARINE WATERS

- marine hydrology
- marine water quality

## V. LAND

- geology and geologic history
- hazards
- soils and soil quality

## VI. BIOTA

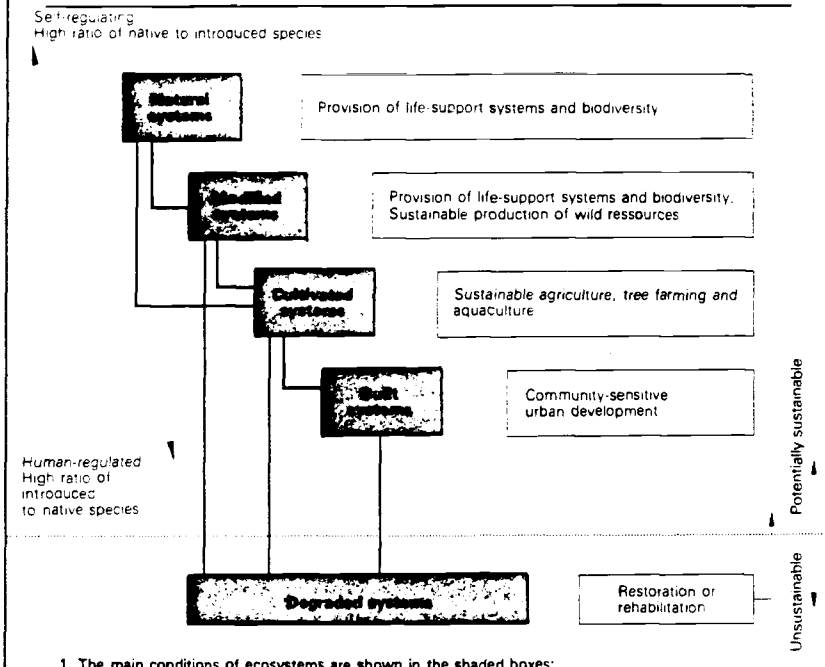
- terrestrial fauna
- wetlands
- exotic species
- flora
- freshwater fish and aquatic fauna
- marine water fish and aquatic fauna

*Source: drawn from the review of 220 SOE reports summarized in Hodge, in progress.*

# APPENDIX III

# PRESCOTT ALLEN'S ECOSYSTEM CLASSIFICATION WITH NOTES

**Fig. 1. Classification of ecosystem conditions**




1. The main conditions of ecosystems are shown in the shaded boxes:

**Natural systems.** Ecosystems where since the industrial revolution (1750) human impact (a) has been no greater than that of any other native species, and (b) has not affected the ecosystem's structure. Climate change *is excluded from the definition, because human-caused climate change is likely to affect* all ecosystems and eliminate all natural ecosystems as defined here.

**Modified systems.** Ecosystems where human impact is greater than that of any other species, but whose structural components are not cultivated. Most of the planet is now modified, including land and sea areas usually considered "natural". For example, naturally regenerating forest used for timber production; naturally regenerating range land used for livestock production.

**Cultivated systems.** Ecosystems where human impact is greater than that of any other species, and most of whose structural components are cultivated: e.g. farmland, sown pasture, plantations, aquaculture ponds.

**Built systems.** Ecosystems dominated by buildings, roads, railways, airports, docks, dams, mines, and other human structures.

**Degraded systems.** Ecosystems whose diversity, productivity and habitability have been substantially reduced. Degraded land ecosystems are characterized by loss of vegetation and soil. Degraded aquatic ecosystems are often characterized by polluted water that can be tolerated by few species.

2. The arrows on the left indicate that the slope from natural systems to built systems represents a change from self-regulation toward regulation by humans, a decline in the diversity of native species, and a rise in the diversity of introduced species.

3. Main steps today in the conversion of natural ecosystems to other conditions are shown by the heavy lines: other significant steps by the light lines.

4. Potentially sustainable ecosystem conditions are above the dotted horizontal line. Potentially sustainable uses of each ecosystem condition are summarized to the right of the shaded boxes. Uses of an ecosystem are sustainable if they are compatible with maintenance of the ecosystem in that condition. Unsustainable uses lead to conversion of the ecosystem to some other condition.

5. Living sustainably calls for protection of natural systems + sustainable production of wild renewable resources from modified systems + sustainable production of crops and livestock from cultivated systems + development of built systems in ways that are sensitive to human and ecological communities + restoration or rehabilitation of degraded systems.

By Robert Prescott Allen

*Source: IUCN, 1991, p. 34.*

# APPENDIX IV

# MONITORING AND ASSESSING HUMAN WELL-BEING

## I. FOOD - NUTRITION - HEALTH - SURVIVAL

### A. PREVENTATIVE/ANTICIPATORY

- food/nutrition: consumption habits, obesity, malnutrition
- sleep
- worry
- physical fitness
- spiritual well-being: importance and self-evaluation of spiritual well-being; formal/informal religion
- freedom/loss of freedom
- personal savings/debt
- fear of/confidence in the future
- dependency: individual self-reliance
- life satisfaction of individuals

### B. REACTIVE

- occurrence of disease
- life expectancy
- mortality: under 5 years old; maternal; untimely deaths
- characteristics of the health care system: facilities, personnel, program delivery

## II. KNOWLEDGE, LITERACY, AND EDUCATION

- knowledge and literacy levels
- schooling (formal and informal): types, participation rates, opportunities; government and private support
- skill development: types, participation rates, opportunities; government and private support

## III. MATERIAL WEALTH, POVERTY, UNPAID WORK, AND EMPLOYMENT

- material wealth: annual income; difference between income and expenditures; savings rate
- poverty: population below the poverty line; numbers of homeless; level and types of social assistance required
- unpaid work: types, participation rates, satisfaction
- employment: types, rates, labour organizations, satisfaction, opportunities for rewarding employment - financial and otherwise
- public aid and debt

## IV. LEISURE

- activity options and participation rates
- support organizations
- government/private support

## V. COMMUNITY: SOCIAL FABRIC AND COMMUNITY WELL-BEING

- empowerment: amount of community participation and control in decision-making
- empowerment: participation rates in elements of the "civil society" (self-defined non-government organizations)
- community: sense of satisfaction and spirit
- dependency: collective self-reliance
- cultural characteristics/diversity
- cultural interrelationships
- presence of special community features and cultural events leading to community identity and pride
- existance/loss of freedom and openness
- family structure; family break-up
- safety and crime
- social security expenditures

## VI. COMMUNITY: STATE OF BUILT INFRASTRUCTURE AND SUPPORT SYSTEMS

- housing (ownership, physical characteristics, surroundings, overcrowding, length of residence, satisfaction, likes and dislikes)
- commercial facilities
- water and sewage
- energy supply
- transportation
- recreation facilities

*Source: Compiled on the basis of literature regarding the determinants of human health (Evans and Stoddart, 1990; Hertzman, 1990); quality of life (Dann, 1984); state of human development (UNDP, 1991); and healthy cities (YUCHS, 1990).*

# APPENDIX V - AGENDA 21

## A. STRUCTURE AND CONTENT (CHAPTER REFERENCES IN BRACKETS)

### I. Social and Economic Dimensions

- accelerating sustainable development (2)
- poverty (3)
- consumption patterns (4)
- population growth (5)
- human health (6)
- human settlements (7)
- integrating environmental costs into decision-making (8)

### II. Resource Management

- atmospheric protection (9)
- land-use (10)
- deforestation (11)
- desertification (12)
- mountain development (13)
- agriculture and rural development (14)
- biodiversity (15)
- biotechnology (16)
- ocean protection (17)
- fresh water protection and management (18)
- toxic chemicals (19)
- hazardous waste (20)
- solid waste, sewage (21)
- radioactive waste (22)

### III. Strengthening Major Groups

- participation (23)
- women (24)
- children and youth (25)
- indigenous people (26)
- non-governmental organizations (27)
- local authorities (28)
- workers, unions (29)
- business, industry (30)
- science, technology (31)
- farmers (32)

### IV. Implementation

- financial resources and mechanisms (33)
- education and public awareness (36)
- international institutions (38)
- legal institutions and mechanisms (39)
- technology transfer (34)
- science for sustainable development (35)
- capacity building (37)
- bridging the data gap (40)

*Source: UNCED, 1992.*

## B. ELEMENTS OF AGENDA 21 GROUPED BY THE PROPOSED FRAMEWORK (CHAPTER REFERENCES IN BRACKETS)

### Ecosystem

- air and climate (9)
- dry-land ecosystems (12)
- cultivated ecosystems (14)
- coastal, island, and marine ecosystems (17)
- data, information, and analysis (40)
- forest ecosystems (11)
- mountain ecosystems (13)
- biological diversity (15)
- freshwater ecosystems (18)

**Interface**: stress from human activities including:

- trade (2)
- consumption (4)
- other activities contributing to atmospheric conditions (energy production and use, transportation, industrial development, agriculture and land use)(9)
- other activities contributing to freshwater conditions (18)
- hazardous waste generation, storage, and management (21)
- radioactive waste generation, storage, and management (22)
- poverty (3)
- settlements (7)
- deforestation (11)
- desertification (12)
- agriculture (14)
- biotechnology (16)
- fishing, shipping, tourism (17)
- solid waste generation, storage and management (20)
- data, information, and analysis (40)

### People

- demographic dynamics (5)
- poverty (3)
- human health (6)
- women (24)
- indigenous people (26)
- local authorities (28)
- workers and trade unions (29)
- scientific and technological community (31)
- financial resources and mechanisms (33)
- education and public awareness (36)
- institution building (38)
- data, information, and analysis (40)
- trade and cooperation (2)
- consumption (4)
- settlements (7)
- youth (25)
- non-governmental organizations (27)
- business and industry (30)
- farmers (32)
- technology transfer (34)
- science (35)
- capacity building (37)
- legal instruments and mechanisms (39)

### Synthesis

- integrated policy-making for sustainable development (8)
- integrated land-resource management (10)
- data, information, and analysis (40)

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